空氣污染物爲害農作物之徵狀診斷[1]

Symptoms Diagnosis of Air Pollution Injury to Vegetation

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摘 要

主要的空氣污染物有二氧化硫、氮氧化物、臭氧和氟化物等。二氧化硫爲害作物的主要徵狀爲葉脈間黃化現象，如絲瓜、木瓜、蕃石榴或是葉脈間條紋斑，如水稻；然而也有葉尖、葉緣黃化現象，如水稻、甘蔗、花生和玉米等。氮氧化物比較沒有典型的爲害徵狀，通常可能是葉間黃化現象，如甘藍；或葉間條紋斑，如劍蘭；但也有葉尖、葉緣黃化現象，如劍蘭等。臭氧的主要爲害徵狀爲葉脈間斑點、斑塊或刺點等，如胡瓜、油菜等；但也有葉尖黃化現象，如劍蘭、蕨類等。氟化物的主要爲害徵狀爲葉尖、葉緣黃化現象，如水稻、香蕉、鳳梨、劍蘭、相思樹和台灣橄欖等。

關鍵詞：空氣污染物、二氧化硫、氮氧化物、臭氧、氟化物

ABSTRACT

Major air pollutants are sulfur dioxide, oxides of nitrogen, ozone and fluorides. Major symptoms developed by sulfur dioxide injury to vegetation are interveinal bleaching and necrosis, e.g. vegetable sponge, papaya, guava, etc. Interveinal streaks is also a major symptoms, e.g. rice. However, tip and marginal necrosis can also be observed, e.g. rice, sugar cane, peanut, maize, etc.

1.本研究報告爲農試所多年來試驗研究之綜合報告。
2.農試所農化系副研究員、助理、技術員。

There are no reliable or typical symptoms developed by oxides of nitrogen injury. A nonspecific chlorosis may be occurred, e.g. cabbage; or interveinal streaks, e.g. gladiolus; or tip and marginal necrosis, e.g. gladiolus. Major symptoms developed by ozone injury are interveinal fleck, stipple and mottle, e.g. cucumber, chinese mustard, etc. However, tip and marginal necrosis can also be observed, e.g. gladiolus and fern. Major symptoms developed by fluorides injury are tip and marginal necrosis, e.g. rice, banana, pineapple, gladiolus, acacia, Chinese olive, etc.

Key words: Air pollutants, sulfur dioxide, oxides of nitrogen, ozone, fluorides.

前　　言

近年來台灣工商業發達，工廠林立，交通工具也急速增加，因而空氣污染事件也跟著增多，同時空氣污染物也可能爲害農作物之生長(Jacobson and Hill 1970; Lacasse and Treshow 1978; Manning and Feder 1980; Mudd and Kozlowski 1975; Ormrod 1978; Reinert 1975)。空氣污染物爲害農作物時常於植物葉子表面產生受害徵狀，因此，如果能夠詳細研究各種空氣污染物爲害農作物所產生的葉面受害徵狀，將來可做爲公害糾紛鑑定之重要參考依據。本報告係於農試所實驗室薰蒸設備中以已知濃度之主要空氣污染物二氧化硫、氮氧化物、臭氧和氟化物來薰蒸處理各種不同農作物使其葉面產生受害徵狀以做爲未來鑑定之參考。

材料與方法

一、植物栽培：

試驗用作物栽培於盆栽土，盆栽土係以農田土壤或使用1：1(泥炭土：蛭石)爲材料，然後調加作物生長需要所需之養分。

二、薰蒸工作於植物生長箱中進行，生長箱中另有一壓克力製成之薰蒸室。薰蒸室內對角之上方有兩個循環扇，可使氣體充分混合,並可減少植物葉面界面阻力(boundary layer resistance)。生長箱可控制溫度、濕度及光度。生長箱之溫度晝25℃，夜20℃，相對濕度70％，光線強度爲7000 lux。主要空氣污染物，如臭氧氣體係由 Griffin Model GTC-1A Ozone Generator 所產生，而二氧化硫、二氧化氮與氟化氫氣體各由氣體鋼瓶供應並由調節器調節其流量後通到氣體混合裝置，與由氣體壓縮機打出之空氣以適當比率混合，再通入薰蒸室內。此薰蒸室完全封閉，僅留一孔讓空氣與空氣污染物混合體經由Teflon管將氣體引導到空氣污染偵測儀，而連續的記錄其濃度。而所使用之各種空氣污染偵測儀則是：二氧化硫偵測儀係用 Thermo electron model 43 pulsed fluorescent SO_2 analyzer 或 Model 8850 fluorescent SO_2 analyzer；氮氧化物偵測儀係用 Chemiluminescent NO-NO_2-NO_x analyzer；臭氧偵測儀係用 Griffin model Eg-2001-LC Ozone monitor；而氟化物偵測儀係用 CEA 555 Air monitor 或 TGM 555 Air monitor 來檢定。

三、薰蒸試驗：

作物於溫室中生長至適當時期，移至生長箱（未通任何氣體）內，讓其在此箱中一段時間以適應人工環境後再移入有空氣污染物氣體之薰蒸室內進行試驗，薰蒸一晝夜後再將作物放回溫室2至3天左右，讓其受害情形顯示出來，記錄植株受害情形，並拍攝受害圖片。

結果與討論

主要的空氣污染物有二氧化硫、氮氧化物、臭氧和氟化物等。二氧化硫爲害作物的主要徵狀爲葉脈間黃化現象，如絲瓜、木瓜、蕃石榴(圖 1至圖 3)或是葉脈間條紋斑，如水稻(圖4)；然而也有葉尖、葉緣黃化現象，如水稻、甘蔗、花生和玉米(圖 5至圖 8)等。氮氧化物比較沒有典型的爲害徵狀，通常可能是葉間黃化現象，如甘藍(圖 9)；或葉間條紋斑，如劍蘭(圖10)；但也有葉尖、葉緣黃化現象，如劍蘭(圖11)等。臭氧的主要爲害徵狀爲葉脈間斑點、斑塊或刺點等，如胡瓜、油菜(圖12至圖13)等；但也有葉尖黃化現象，如劍蘭、蕨類(圖14至圖15)等。氟化物的主要爲害徵狀爲葉尖、葉緣黃化現象，如水稻、香蕉、鳳梨、劍蘭、相思樹和台灣橄欖(圖16至圖21)等。

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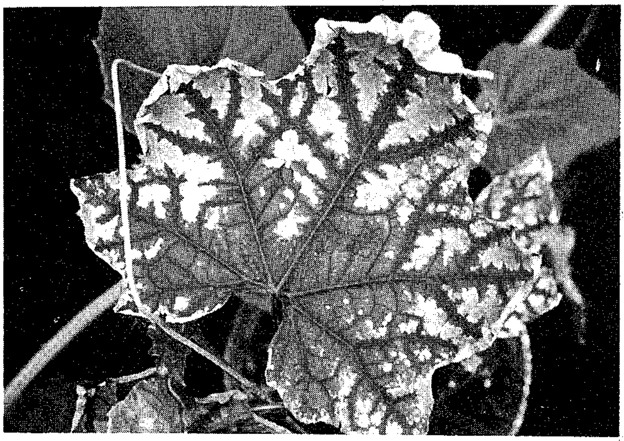

圖1. 二氧化硫爲害絲瓜情形。(葉脈間黃化)

Fig 1. SO_2 injury to vegetable sponge. (Interveinal necrosis).

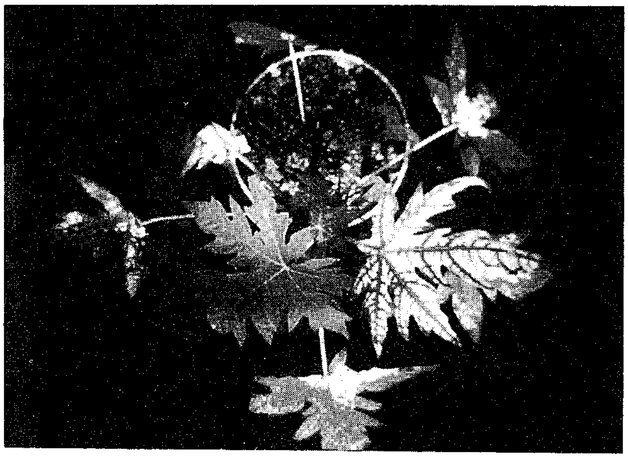

圖2. 二氧化硫爲害木瓜情形。(葉脈間黃化)

Fig 1. SO_2 injury to papaya. (Interveinal necrosis)

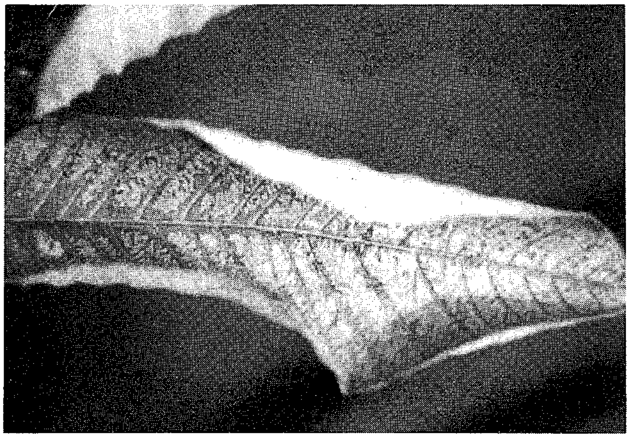

圖3. 二氧化硫爲害蕃石榴情形。(葉脈間黃化)

Fig 3. SO_2 injury to guava. (Interveinal necrosis)

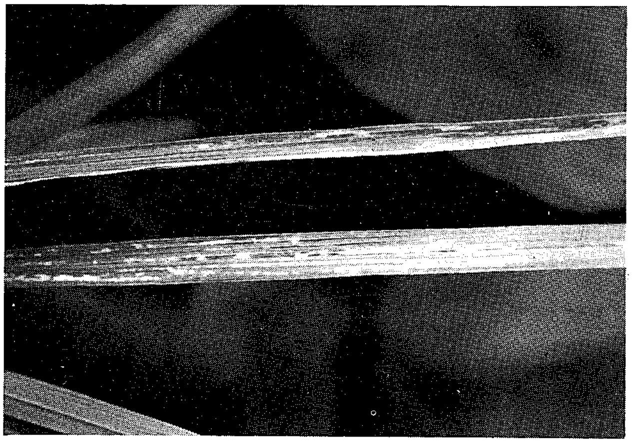

圖4. 二氧化硫爲害水稻情形。(葉脈間條紋斑)

Fig 4. SO_2 injury to rice. (Interveinal streaks)

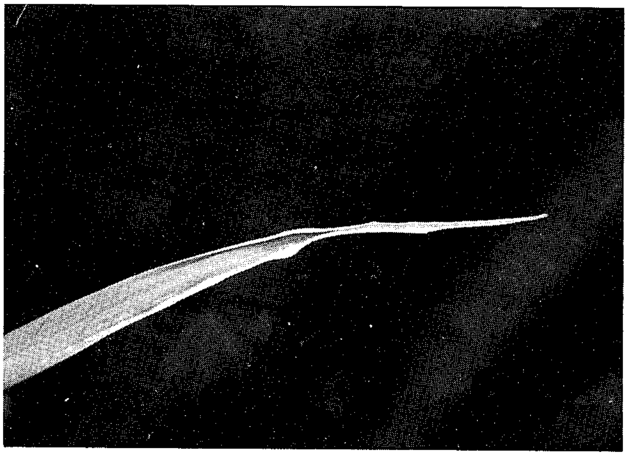

圖5. 二氧化硫爲害水稻情形。(葉尖、葉緣黃化)

Fig 5. SO_2 injury to papaya. (Tip and marginal necrosis)

圖6. 二氧化硫爲害甘蔗情形。(葉尖、葉緣黃化)

Fig 6. SO_2 injury to sugar cane. (Tip and marginal necrosis)

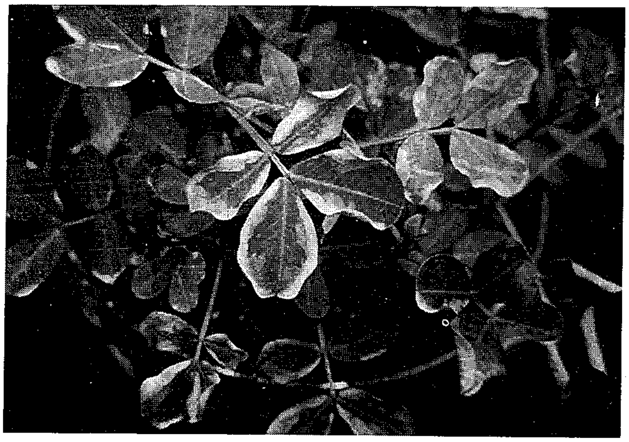

圖 7. 二氧化硫爲害花生情形。(葉尖、葉緣黃化)

Fig 7. SO_2 injury to peanut. (Tip and marginal necrosis)

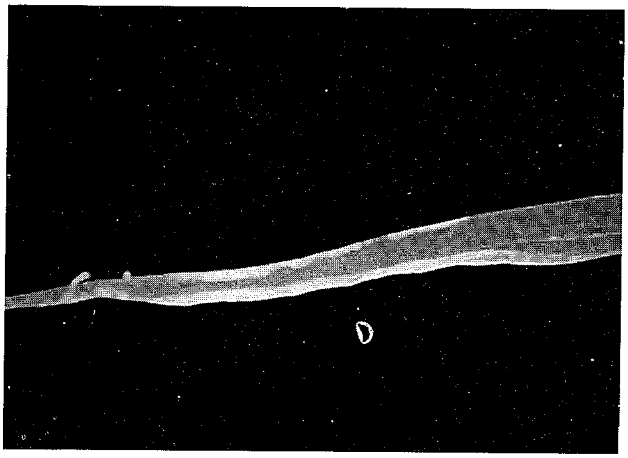

圖 8. 二氧化硫爲害玉米情形。(葉尖、葉緣黃化)

Fig 5. SO_2 injury to maize. (Tip and marginal necrosis)

圖 9. 氮氧化物爲害甘藍情形。(葉間黃化)

Fig 9. NOx injury to cabbage. (Interveinal Streaks)

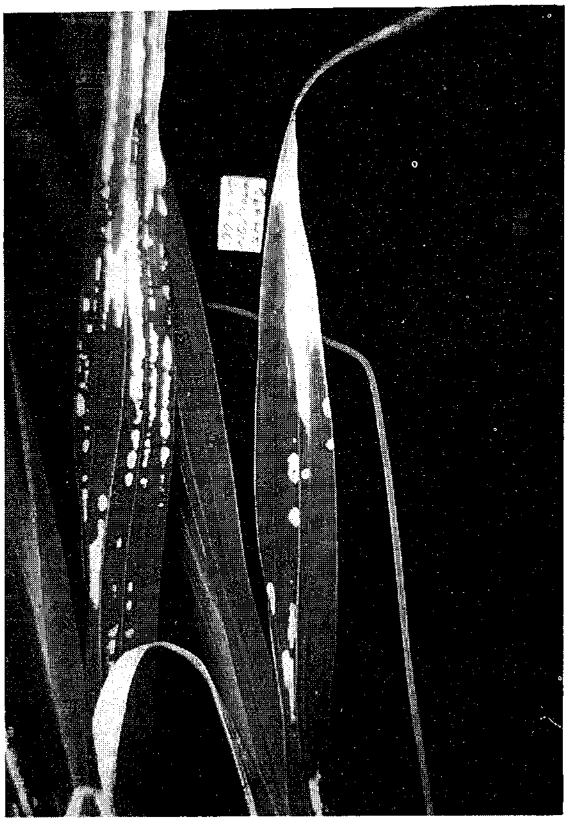

圖10. 氮氧化物爲害劍蘭情形。(葉間條紋斑)

Fig 10. NOx injury to gladiolus. (Interveinal Streaks)

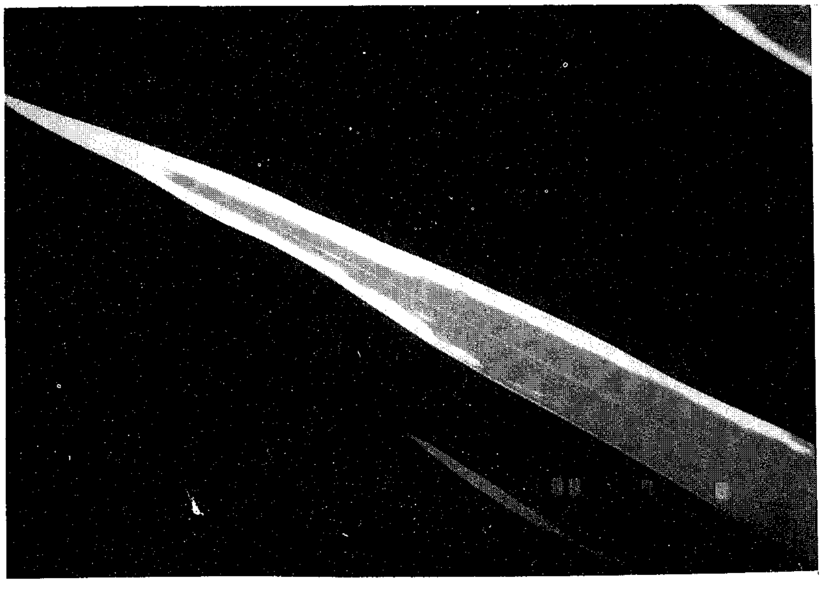

圖11. 氮氧化物爲害劍蘭情形。(葉尖、葉緣黃化)

Fig 11. NOx injury to gladiolus. (Tip and marginal necrosis)

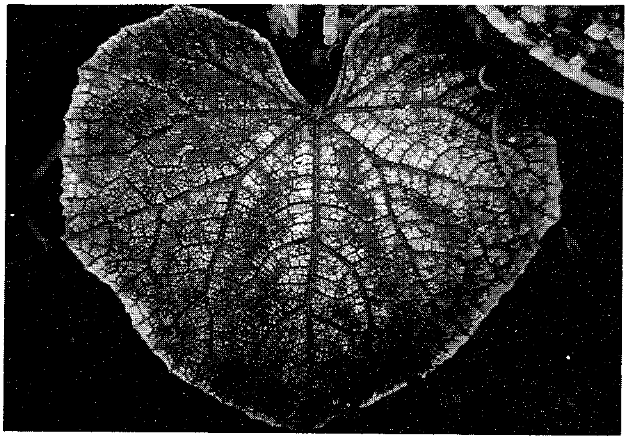

圖12. 臭氧爲害胡瓜情形。(葉脈間斑點、斑塊或刺點)

Fig 12. Ozone injury to cucumber. (Interveinal fleck, stipple and mottle)

圖13. 臭氧爲害油菜情形。(葉脈間斑點、斑塊或刺點)

Fig 13. Ozone injury to chinese mustard. (Interveinal fleck, stipple and mottle)

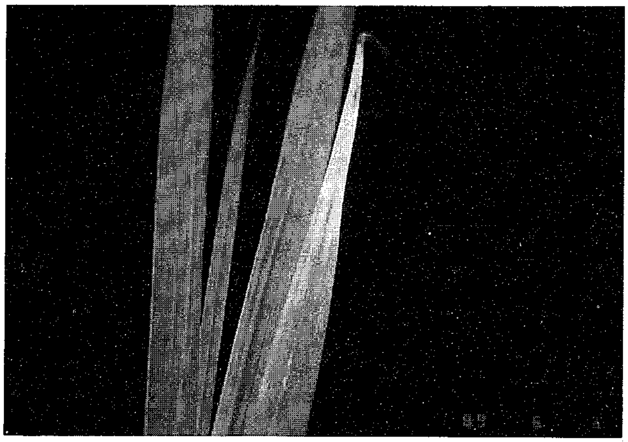

圖14. 臭氧爲害劍蘭情形。(葉尖黃化)

Fig 14. Ozone injury to gladiolus. (Tip necrosis)

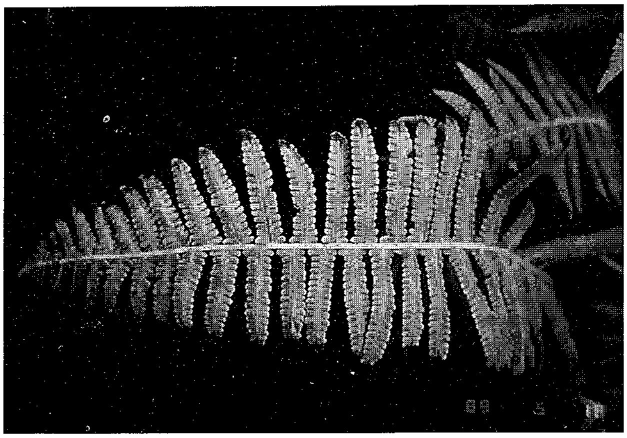

圖15. 臭氧爲害蕨類情形。(葉尖黃化)

Fig 15. Ozone injury to fern. (Tip necrosis)

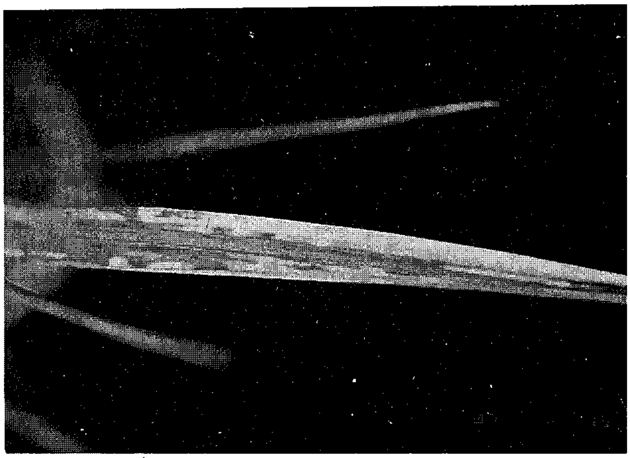

圖16. 氟化物爲害水稻情形。(葉尖、葉緣黃化)

Fig 16. Fluoride injury to rice. (Tip and marginal necrosis)

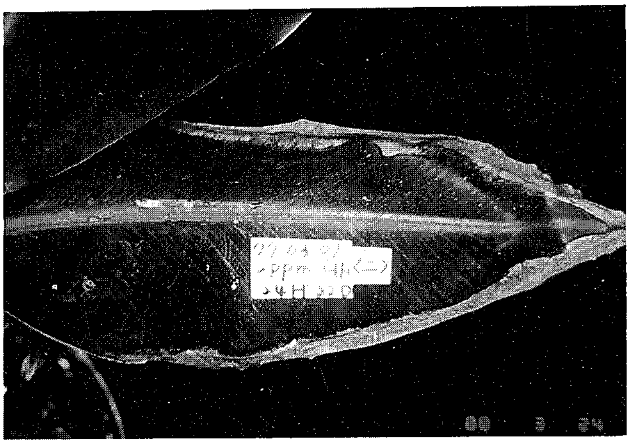

圖17. 氟化物爲害香蕉情形。(葉尖、葉緣黃化)

Fig 17. Fluoride injury to banana. (Tip and marginal necrosis)

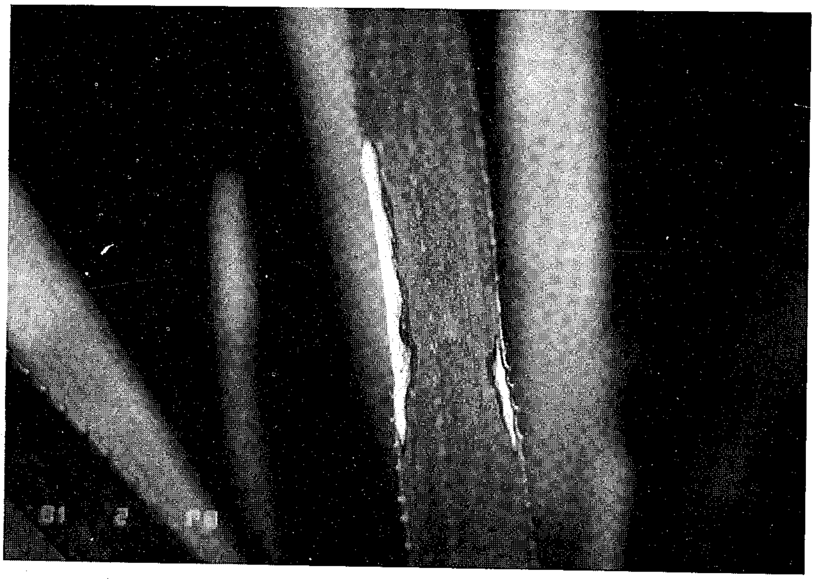

圖18. 氟化物爲害鳳梨情形。(葉緣黃化)

Fig 18. Fluoride injury to pineapple. (Marginal necrosis)

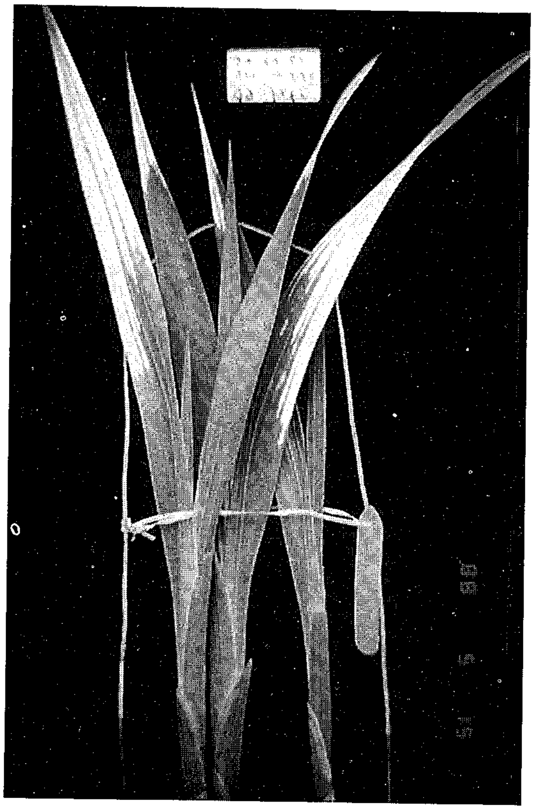

圖19. 氟化物爲害劍蘭情形。(葉尖、葉緣黃化)

Fig 19. Fluoride injury to gladiolus. (Tip and marginal necrosis)

圖20. 氟化物爲害相思樹情形。(葉尖黃化)
Fig 16. Fluoride injury to acacia. (Tip necrosis)

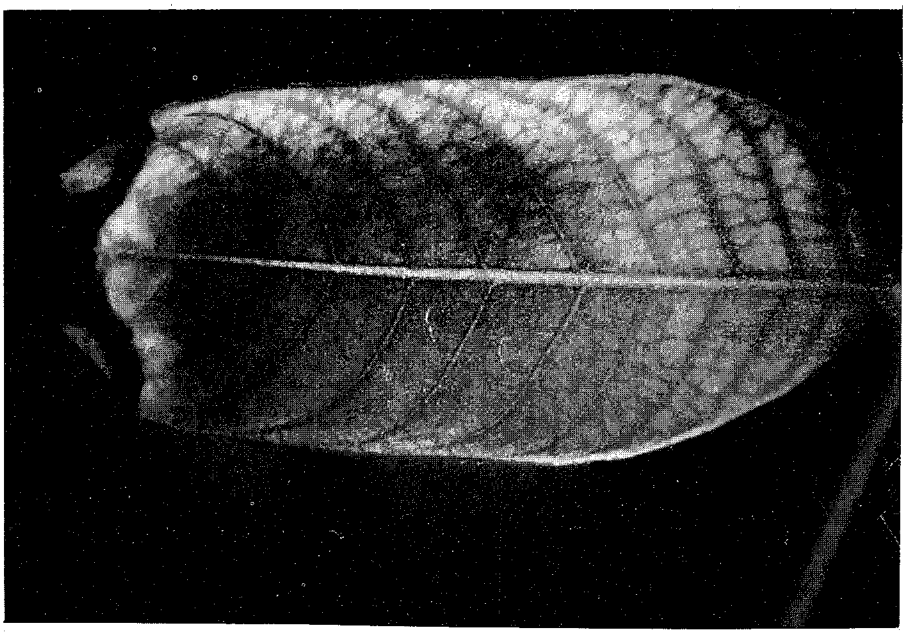

圖21. 氟化物爲害台灣橄欖情形。(葉尖黃化)
Fig 21. Fluoride injury to Chinese olive. (Tip necrosis)